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**AMENDED SPECIFICATION**

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**PATENT SPECIFICATION**

**537,234**



**Application Date: Dec. 11, 1939. No. 31963/39.**

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**Complete Specification Accepted: June 13, 1941.**

**PROVISIONAL SPECIFICATION**

**Improvements in Closure Devices for Storage Compartments  
of Aircraft**

We, GENERAL AIRCRAFT LIMITED, a British Company, of the London Air Park, Feltham, Middlesex, and GEORGE BERRELL LEATHER, a British Subject, of the Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to closure devices for preserving the continuity of aircraft skins where compartments are provided 10 to accommodate such gear for instance as bomb racks, retractable undercarriage elements, et cetera.

Such closures as now devised either slide, in which case difficulties are apt to occur 15 due to frictional binding, or, alternatively, suffer from the disadvantage that when opened up they present considerable resistance both in the slip stream and to their own movement, with the result that they 20 are only able to be opened with difficulty where they are of large dimensions on fast-moving aircraft.

The present invention has for an object 25 to overcome such a disadvantage, and accordingly may be said to consist in the conception of mounting the closure in such a manner that it swings bodily about an axis within the aircraft structure so that the closure is actually within the 30 aircraft in a fully-open condition, whereas it is able in the closed condition to seal the compartment effectively maintaining continuity of the aircraft skin.

In carrying the invention into effect 35 according to a preferred embodiment and as applied by way of example to a closure for a bomb compartment or for the storage space for a retractable undercarriage, the closure flap conforms in the aerodynamic 40 sense to the shape of the aircraft skin immediately surrounding the opening of the compartment. At or near each end the closure is provided with a bracket, the brackets in fact being arranged to form a 45 pair and being apertured for mounting to swing about a common axis. In order to

facilitate swinging movement of the closure member in relation to the opening, the closure member is preferably curved somewhat, as may also be the edges immediately 50 surrounding the opening, the closure member together with its end brackets comprising an elongated sector-shaped structure swingable about an axis; the whole structure being at all times maintained 55 within the aircraft when the compartment is open.

The arrangement above described has many advantages; apart from the fact 60 that the closure can be operated without affecting the aerodynamic profile of the aircraft structure, it is also capable of being operated very simply, for instance by a Bowden cable, or for that matter any sort 65 of cable or wire connection extending to some convenient remote operating point. If it is inconvenient to attach the operating means to the closure itself, the closure may be operated by means directly associated 70 with the axis about which it swings.

In some cases stops may be provided for limiting movement of the closure, but it may also be convenient to mount the closure so that it can swing completely 75 through 360°, so that continued movement in one direction will eventually effect both opening and closing.

Where the closure is mounted to swing 80 in a fore and aft sense with respect to the aircraft, it is conceivable that a projection may be deliberately provided to extend 85 into the slip stream, so that there is a definite tendency for the closure to shut up the compartment at all times except when the closure is deliberately retained in the open condition. The same effect may of course be achieved by counterbalancing the closure so that it normally assumes the closed condition except when deliberately actuated for opening. It may 90 be desirable however, especially where the closure is a member of substantial size, to

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counter balance the closure to facilitate opening.

The axis about which the closure swings may be real or imaginary, and it may be fixed or movable. Similarly, the closure may swing in a fore and aft, transverse, or in any other required sense.

If desired, the closure means may be of interrupted drum form so as to provide 10 a number of alternate openings and spaces, thereby enabling a number of opening and closing operations to be effected quickly with unidirectional rotation of the drum assembly.

Although in most cases the closure is intended to be flush-fitted with the immediately surrounding aircraft skin, there may be reason in some circumstances for it to afford a protrusion in the closed condition.

20

Dated the 11th day of December, 1939.

For the Applicants :

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#### COMPLETE SPECIFICATION

#### Improvements in Closure Devices for Storage Compartments of Aircraft

We, GENERAL AIRCRAFT LIMITED, a British Company, of The London Air Park, Feltham, in the County of Middlesex, and 25 GEORGE BERRELL LEATHER, a British Subject, of the Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following 30 statement :—

This invention relates to closure devices for preserving the continuity of aircraft skins where compartments are provided to accommodate such gear, for instance, as 35 bomb racks, retractable undercarriage elements, et cetera.

Such closures as now devised either slide, in which case difficulties are apt to occur due to frictional binding, or, alternatively, 40 suffer from the disadvantage that when opened up they present considerable resistance both in the slip stream and to their own movement, with the result that they are only able to be opened with difficulty 45 where they are of large dimensions on fast-moving aircraft.

The present invention has for an object to overcome such a disadvantage, and accordingly may be said to consist in the 50 conception of mounting the closure in such a manner that it is operable independently of the retractable component and swings bodily about an axis within the aircraft structure so that the closure is actually 55 within the structure when the compartment is in a fully-open condition, whereas it is able in the closed condition to seal the compartment effectively maintaining continuity of the aircraft skin.

In order that it may be clearly understood and readily carried into effect, the invention 60 is hereinafter described with reference to

the accompanying diagrammatic drawings, of which :—

Figure 1 is a fragmentary diagrammatic 65 side elevation illustrating the invention as applied to a closure of the stowage compartment for a retractable undercarriage leg ; and

Figures 2 and 3 are respectively a fragmentary side elevation and end elevation of the invention as applied to a closure for a bomb rack in an aircraft.

Referring now to Figure 1, the undercarriage shown in the extended position 75 at 4 is when retracted, as indicated at 4<sup>1</sup> received in the stowage compartment 5. The undercarriage when it is swung up in retraction passes through an opening in the skin 6, closing the under side of the stowage 80 compartment. The opening is closed by the closure plate 7, which is shaped to conform to the contour of the surrounding skin 6. The closure plate is suspended from the pivot anchorage 8 suitably fixed 85 in relation to the aircraft structure, the connection between the closure plate 7 and the pivot 8 being afforded by laterally-spaced brackets each composed of the arms 9. The brackets 9 and the associated 90 pivot 8 are of course disposed one on each side of the undercarriage in the stowed condition, as indicated at 4<sup>1</sup>.

Any convenient means may be provided for swinging the closure to open or close 95 the stowage compartment 5, and there has been illustrated in Figure 1 a remotely controllable fluid pressure jack having the cylinder 10 carried upon the fixed pivot 11. In that case the jack plunger, indicated at 100 12, is pivoted to one of the bracket arms 9, and it follows that when the jack is operated for retraction the closure is swung up about the pivot to open the stowage compartment

- whereas when the jack is extended the closure is swung down to close the compartment. The brackets 9 and pivot 8 may be so related to the closure plate 7 that when 5 the closure is swung up to open the stowage compartment the part 7<sup>1</sup> remains projecting down as shown so that the jack action is in closure assisted by the airflow over the skin 6 when the aircraft is in flight.
- 10 Although the arrangement shown in Figure 1 illustrates the invention as applied to a fore-and-aft retraction scheme, it could be applied equally well to a sideways retraction scheme, but in that case it 15 would probably be preferable to dispose the axis about which the closure swings parallel to the longitudinal axis of the aircraft instead of transverse thereto, as shown in Figure 1.
- 20 An arrangement in which the closure swings about a longitudinal axis has been illustrated as applied to a closure for a bomb rack in Figures 2 and 3. Bombs have been indicated at 13, and apart from 25 the fact that in the arrangement shown in Figures 2 and 3 the axis 8<sup>1</sup> is disposed substantially longitudinally, and that the brackets 9 and closure plate 7 swing transversely, the nature and function of 30 the bomb compartment closure is exactly the same as that described with reference to Figure 1.
- The arrangements above described have many advantages; apart from the fact 35 that the closure can be operated without affecting the aerodynamic profile of the aircraft structure, it is also capable of being operated very simply, for instance by a remotely controllable fluid pressure actuated jack, as illustrated, by a Bowden cable, or for that matter by any sort of cable or wire connection extending to some convenient remote operating point. If it is 40 inconvenient to attach the operating means to the closure itself, the closure may be operated by means directly associated with the axis about which it swings.
- In some cases stops may be provided for 45 limiting movement of the closure, but it may also be convenient to mount the closure so that it can swing completely through 360°, so that continued movement in one direction will eventually effect both opening and closing.
- 50 The closure may be counterbalanced so that it normally assumes the closed condition except when deliberately actuated for opening. It may be desirable, however, especially where the closure is a member of 55 substantial size, to counterbalance the closure to facilitate opening.
- The axis about which the closure swings 60 may be real or imaginary, and it may be fixed or movable.
- 65 If desired, the closure means may be of interrupted drum form so as to provide a number of alternate openings and closed spaces, thereby enabling a number of opening and closing operations to be effected quickly with unidirectional rotation 70 of the drum assembly.
- Although in most cases the closure is intended to be flush fitted with the immediately surrounding aircraft skin, there may be reason in some circumstances 75 for it to afford a protrusion in the closed condition.
- We are aware of Patent No. 576,824 and make no claim to the invention claimed 80 therein which comprises means for controlling the opening of a panel or door, especially for an aeroplane characterised by an arrangement such that, starting from the closed position in which the door or panel substantially effects the surface 85 continuity of the wall which includes the opening or space to be closed, the said means first enables the door to be moved transversely by at least the thickness of the said wall and then to be moved 90 laterally to clear the aperture.
- According to a further feature of the invention as covered in a subsidiary claim the invention was characterised by the fact that the opening was effected in two stages, 95 namely, in the first place, the movement of the door by at least the thickness of the adjacent wall, and, in the second place, a lateral aperture clearing movement in the interior of the fuselage.
- Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that subject to the 100 above disclaimer what we claim is:—
1. An aircraft structure including a stowage compartment for a retractable component in which a closure for the compartment operable independently of the retractable component, comprises a member swingable bodily for opening and closure about an axis within the aircraft structure whereby the closure is actually within the structure when the compartment is in a fully-open condition, whereas it is able in the closed condition to seal the compartment effectively while maintaining 110 continuity of the aircraft skin.
2. An arrangement as set forth in Claim 1, in which the closure includes a closure plate effective in a closed condition for sealing the opening through which the retractable component moves in retraction and extension, the plate being carried by spaced brackets swingable about a common 115 axis.
3. An arrangement as set forth in Claim 2, in which the closure is arranged to swing unidirectionally through 360° to effect both opening and closing.

4. An arrangement as set forth in Claim 1, in which the closure is of drum form, the periphery of the drum being defined by spaced panels to constitute alternate openings and closures on unidirectional rotation of the drum.
5. An arrangement as set forth in any of the preceding claims including remotely controllable means for effecting opening 10 and/or closure.
6. An arrangement as set forth in any of the preceding claims, in which the axis about which the closure swings is disposed transversely of the aircraft structure, the closure leaving exposed exterior of the aircraft skin a portion to project into the airflow when the aircraft is in flight, whereby at least to assist in closure.
7. The improved closure for a retractable undercarriage stowage compartment substantially as described with reference to Figure 1 of the accompanying diagrammatic drawings.
8. The improved closure for a bomb compartment substantially as described 25 with reference to Figures 2 and 3 of the accompanying diagrammatic drawings.

Dated this 11th day of December, 1940.

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[This Drawing is a reproduction of the Original on a reduced scale.]

